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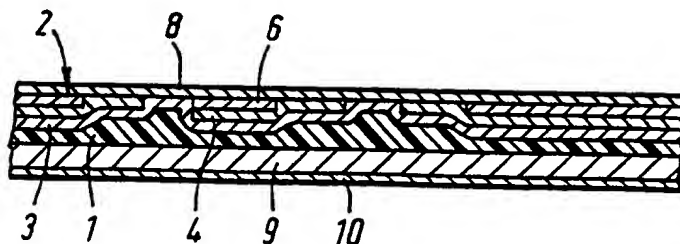
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(54) Title: MAGNETIC DATA MEDIUM AND ITS PRODUCTION, DATA SYSTEM AND DATA DECODING DEVICE



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(57) Abstract

A magnetic data card comprises a data region bearing a magnetic recording material whose thickness along the axis varies in accordance with a predetermined pattern which provides a magnetic watermark underlying the recorded data, which can be used to verify the authenticity of the card. The variable thickness is achieved by printing a first layer (3) of magnetic recording material directly onto a substrate (1), a second layer (4) in a discontinuous pattern onto the first layer (3) and a third layer (6) in a different discontinuous pattern onto the second layer (4).

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MAGNETIC DATA MEDIUM AND ITS PRODUCTION, DATA SYSTEM
AND DATA DECODING DEVICE

This invention relates to a magnetic data medium, for example a magnetic tape, a bank card, a credit card, a telephone prepayment card, or a railway ticket.

Conventional bank cards and credit cards are typically of the "read only" type, in which relevant account data is initially recorded in a layer formed, for example, from magnetic tape comprising a magnetic coating on a substrate, and thereafter read back for each transaction without being changed.

Some types of card, for example telephone prepayment cards, require data to be written to the card at each transaction for which it is used, for example leaving a record of prepaid telephone units remaining from the original value of the card. Such cards typically use a layer of high coercivity material to resist fraud, since it is difficult to record onto high coercivity material and such recording cannot readily be changed by the user of the card. It is convenient to produce such magnetic layers by printing, for example by screen printing, the magnetic recording material in ink form onto the card substrate. Some types of telephone prepayment card have read-only data

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recorded in certain areas of the card onto originally unmagnetised magnetic recording material. This provides additional security, since each data transition is typically from +1 to 0, from 0 to -1, or vice versa, giving a signal transition half that of the changeable data or read-write areas of the card which, as with most conventional magnetic tape recordings, have transitions from +1 to -1 and vice versa. As the magnetic stripe is usually covered by a protective plastic coating, typically a PVC layer about 40 microns thick, the read head must receive a sufficiently strong signal across this 40 micron spacing. To obtain a sufficiently strong signal from these half transition levels, it is expedient to print the magnetic recording material in more than one layer to obtain sufficient thickness of magnetic material. Typically three layers are printed, one upon the other, to achieve the desired thickness. The magnetic permeability is, of course, a property of the magnetic recording material or materials used, whilst the value of the permeance is a function of the permeability and the dimensions of the magnetic layer. For a given size, read head, the signal strength is a direct function of permeance which in turn is a direct function of the thickness of the magnetic layer.

It is known from UK Patent Specification 2,026,946 for a security magnetic recording support to be in the form of a

strip and to comprise a magnetic recording base having a substantially constant thickness and, in certain areas, reinforcements or increased thickness zones whose coercivity is identical to that of the magnetic recording support base and whose thickness exceed by at least 40% the average thickness of the magnetic recording support base. This structure is achieved by the transfer to a first transfer tape of reinforcements from a second transfer tape by the application of heat and pressure by means of a heated hammer. The first transfer tape, bearing the localised reinforcements from the second transfer tape, is then transferred into alignment with an object, such as a credit card, which is positioned on a support. A vertically movable heated hammer, having a head specially shaped to correspond to the element to be applied, is then used to engage the transfer tape on the object to be processed and, under the combined action of temperature and pressure, the magnetic part of the tape is transferred to the object. In this manner the credit card, or other object, is provided with the magnetic support which may subsequently be covered with a protective film. The strip so formed comprises a matrix of heat-meltable resin and magnetisable particles, the thickness of the magnetisable support being increased in certain defined or undefined areas in such a way that, after the magnetic recording of a signal, the corresponding reading signal is modulated in amplitude by a value greater

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than that obtained by the small variations in thickness resulting from the manufacture of prior art supports. This amplitude modulation of the reading signal is then transformed into a code corresponding to the thickness variations of the magnetic support.

It is an object of the present invention to provide a magnetic data medium (such as a magnetic tape, a bank card, a credit card, a telephone prepayment card, or a railway ticket) with a magnetic region of varying thickness which is formed in an improved manner. Also to provide an improved method of producing a magnetic region of varying thickness on such a magnetic data medium. Also to provide an improved data system utilising a magnetic data medium having a magnetic region of varying permeance.

One aspect of the invention is accordingly concerned with magnetic data medium including a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance. According to this aspect of the invention, the magnetic recording material is defined by a first layer printed onto the substrate and by a second layer in a discontinuous pattern on the first layer. In this manner additional security can be incorporated into a magnetic data medium by varying the printing pattern

between successive layers to produce areas with different thicknesses. The resultant signal transitions from the magnetised material from, say, one printed thickness to two or more printed thicknesses can be detected, thus enabling a wide range of markings such as magnetic signatures or security markings, to be incorporated in the magnetic recording material of the magnetic data card, without the use of transfer tapes or complex tooling, such as heated hammers housing specially profiled heads. Preferably the magnetic recording material is additionally defined by a third layer printed in a different discontinuous pattern on the second layer.

It will be appreciated that the substrate upon which the magnetic material is applied may be of any convenient material, for example plastics, paper or cardboard, and of any desired shape or thickness. The substrate may be a plastics film or tape. A tape in accordance with the invention may be applied to a further substrate such as card or plastics, in conventional manner, or may be utilised on its own.

Preferably the thickness of the magnetic recording material varies in discrete equal steps or multiples thereof. However, it may in certain circumstances be possible to provide a more gentle variation in thickness

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rather than an abrupt change from one multiple of the layer thickness to another.

An overlying disguising layer may be provided to avoid ready copying of the pattern. The pattern of varying magnetic permeance includes a portion of the substrate free from magnetic material. In this manner portions of the structure have no magnetic material thereby providing a greater range of magnetic transitions for the "signature".

In use, an additional level of security may be introduced, if desired, by writing blocks of data into the data region with varying levels of magnetic intensity in the magnetic write head or recording head in a pattern corresponding to the predetermined pattern, such that the signals, when read, appear to be at the same uniform level. This effectively conceals the zones of differing thickness until rewriting at uniform level across the zones produces nonuniform read levels. Conversely, the correct pattern of varying intensity recorded on to a fraudulent card without the same pattern of thicknesses would also produce varying read levels, again readily revealing the attempted fraud.

Each layer of magnetic recording material can be applied by any printing technique suitable for the magnetic material and the selected substrate, more preferably by

screen printing. The substrate is preferably deformed to accommodate the different printed layers thereby presenting a uniform planar surface. For certain applications, a non-magnetic coating layer may be applied over the resultant pattern of magnetic recording material. Preferably the magnetic recording material is sandwiched between the uniform planar surface of the deformed substrate and a cover layer laminated to the substrate.

In the case of bank cards having a single stripe of magnetic recording material thereon, it is conventional to divide the stripe into three distinct tracks, different types of data being recorded on the different tracks. In such a case, a portion of the stripe corresponding to only one, or only two, of the tracks may be formed with a varying thickness to provide security coding. Alternatively, the whole width of the strip may be coded, with the normal data recorded over the coded strip, or only a longitudinal portion of the strip may be coded. Thus the first layer may also define a discrete data region of substantially constant magnetic permeance. The discrete data region may be separate from the region defining the pattern of varying magnetic permeance. The region of magnetic recording material and the substrate may alternatively be substantially coextensive.

Telephone cards typically have multiple data areas, for example corner regions used to permit access of the card into the reading machinery and a central stripe divided into three separate regions, the middle region being rewritten with the residual value of the card, and the outer regions of the stripe containing read only data representing the initial value of the card and, perhaps, security data. With such cards, it would be possible to provide the variable thickness "signature" in only one of the areas or in more than one, as desired. For example, the residual value data area may be provided with a thickness pattern coding, and when the card is read by the card reading machinery, the reader could be arranged to test for the underlying pattern after the value data is erased and before the value remaining data is rewritten at the end of the transaction. According to another feature of the invention the region of magnetic recording material also bears magnetically-recorded data. The intensity of the magnetically-recorded data may vary in accordance with the predetermined pattern whereby a magnetic reading head passed along the axis will detect a substantially uniform signal level.

In general, the magnetic data medium of the invention may comprise a plurality of data regions on its surface, separated by non-magnetic areas, at least one data region consisting of magnetic material whose permeance varies in

accordance with the invention. The data regions may be used as read-only or read-write regions, with a single medium having any combination of these in multiple data regions. In one embodiment, the whole of one surface of a data card may be used as a data region.

It will be appreciated that a magnetic data recording stripe on a data card or the like in accordance with the invention will yield signals in the form not merely of transitions of +1 to -1, or +1 to 0 and 0 to -1, for example, but complex combinations of such signals with transitions arising from thickness variations, for example 1 to $\frac{2}{3}$, $\frac{2}{3}$ to $\frac{1}{3}$, and $\frac{1}{3}$ to 0.

Another aspect of the invention provides a data system comprising a magnetic data medium (or a plurality of such media) in accordance with the invention, and a reader device comprising reading means for reading the pattern of varying signal levels or remanance along the axis of the data medium arising from said predetermined pattern and from the data recorded thereon, means for storing data corresponding to said predetermined pattern, and processing means employing said stored data to process the signals read by said reading means to extract therefrom the recorded data.

According to another aspect of the invention, a method

of making a magnetic data medium which includes a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance, includes printing a first layer of magnetic recording material directly onto at least a portion of the substrate, and printing a second layer of magnetic recording material in a discontinuous pattern on the first layer. The method preferably includes printing a third layer of magnetic recording material in a different discontinuous pattern on the second layer. If desired at least one portion of the substrate may be kept free of magnetic recording material. Preferably the method includes deforming the substrate is after printing of the layers to define a uniform planar surface. The method may also include magnetically recording data over the pattern of varying magnetic permeance.

According to a further aspect of the invention, a data system includes a magnetic data medium formed from a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance and a reader device, the reader device including reading means for reading the pattern of varying signal levels along the region arising from the predetermined pattern and from data recorded thereon, storage means is provided for storing

data corresponding to the predetermined pattern, and processing means is provided to employ said stored data to process the signals read by said reading means to extract therefrom the recorded data. Alternatively a data system may include a reader device and at least one magnetic data medium formed from a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance, and having data signals recorded thereon, the reader device being arranged to read the composite signal comprising the data signal recorded on the pattern of varying magnetic permeance, and to separate the data signal from the underlying magnetic signature defined by the pattern of varying magnetic permeance. The reader device may be arranged to read the data signal from the pitch of the composite signal and to read the magnetic signature from the amplitude of the composite signal. Alternatively the reader device may be arranged to store the composite signal prior to erasing the data signal, subsequently to read the magnetic signature, subsequently to use the magnetic signature to decode the composite signal to obtain the data signal. Preferably the reader device may be arranged finally to restore the data signal for the region.

According to a further aspect of the invention a data decoding device for extracting magnetically-recorded data

from a complex signal read back from a magnetic recording medium in which the thickness of the magnetic recording material varies along the read-back axis in accordance with a predetermined pattern comprises a decoding means for receiving said complex read-back signal, for storing the pattern, and for employing the stored pattern to process the complex read-back signal to extract the recorded data. The decoding device may, for example, be interposed between the reading head of a conventional data card reading device and the data handling components thereof, or at some other stage in the data transmission chain, thus permitting existing card reading terminals to be readily adapted to receive data cards in accordance with the invention.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is an enlarged sectional view through the data region of a data card in accordance with one embodiment of the invention;

Figure 2 is a diagrammatic representation of a bank card in accordance with the invention;

Figure 3 is a diagrammatic representation of a

telephone prepayment card in accordance with another embodiment of the invention;

Figures 4, 5 and 6 are diagrammatic representations of bank cards according to further embodiments of the invention;

Figure 7 is perspective view of a conventional card reading device modified in accordance with another aspect of the invention; and

Figure 8 and 9 are block diagrams of two other modified card-reading devices.

Referring first to Figure 1, a magnetic data card is formed from a first flexible plastics substrate layer 1 with a magnetic stripe 2 printed thereon in three layers. The first layer 3 is a continuous layer of magnetic material applied in an appropriate pattern on the substrate 1 by a silk screening technique using an ink comprising magnetisable particles suspended in a suitable hardenable liquid medium. A second layer 4 is then printed over the first layer 3 in a discontinuous pattern leaving apertures. A third layer 6 is then printed onto the hardened layer 4 in a different discontinuous pattern with different apertures such that the overall thickness of magnetic material varies

along the stripe stepwise from a maximum of three layers to a minimum of one layer so that, when the strip is magnetised by a uniform magnetising field, transitions between three levels of magnetisation can be detected along the strip in a predetermined pattern constituting, in effect, a magnetic "signature". Overlying the magnetic stripe, and indeed the whole face of the card, is a first cover layer 8 providing a surface to the card at a uniform level. The cover layer 8 may be applied by any suitable conventional coating technique, but would preferably be by lamination to ensure planarity of the surface. Thus, a second flexible substrate layer 9, bearing printed data, designs and/or other indication on its lower face is positioned beneath the first substrate layer 1, with a second cover layer 10 on the printed face. After heated lamination, the three printed layers adopt the configuration shown in Figure 1, with the first substrate layer 1 deforming to accommodate the different thicknesses to present a uniform planar upper layer in contact with the cover layer 8.

Figure 2 shows a bank card 20 having a continuous magnetic stripe 21 extending along its length. The magnetic stripe 21 is formed with three parallel regions 21a, 21b and 21c, the first two of which are essentially formed from three coextensive layers of magnetic recording material, printed onto the card in the general manner described

hereinbefore with reference to Figure 1, while the third portion 21c is formed with a pattern of differing thicknesses, again as described with reference to Figure 1. As illustrated in Figure 2, the pattern of thicknesses varies along the length of the card according to a predetermined pattern of 3, 2 and 1 layers, represented by different shading and no shading. The three areas 21a, 21b and 21c represent the regions of a conventional bank card or credit card occupied by the three magnetic tracks, of which one or more may remain unused. The magnetic tracks encode data relating to, for example, the personal identification number (PIN) of the holder and perhaps data relating to the maximum size of transaction permitted, with account-identifying data. The track 21c which is encoded with differing thicknesses may have additional data magnetically recorded in the track in conventional manner, the reading head being adapted to detect the data and, separately, the underlying encoding due to the varying thicknesses.

Figure 3 shows a typical telephone prepayment card for use with a card-operated public telephone. The card has seven distinct data regions consisting of areas of magnetic recording material printed thereon as hereinbefore described. Four corner regions 30, 31, 32 and 33 may be encoded with data which releases the reader mechanism to

admit the card to the reader, while three centrally arranged longitudinal regions 34, 35 and 36 carry data relating to the value of the card, as well as security data. The central region 35 is typically used to store the residual value of the card after use. In use, the reader reads the residual value from this region, wipes the data from the region and then at the end of the transaction, rewrites on to the region data representing the new residual value. Regions 34 and 36 contain, for example, security data and data relating to the original value of the card.

To increase the security of the card, any of these regions may be printed with a pattern of thicknesses as described with reference to Figure 1, the appropriate reading head in the reading mechanism being arranged to detect the pattern of signals arising from the variation in thickness. For example, the corner regions 30 and 31 may be encoded with a predetermined pattern of thicknesses instead of, or as well as, the predetermined magnetic signal recorded in the regions. In the absence of the correct underlying thickness pattern giving rise to a predetermined signal pattern, possibly in conjunction with the overlying recorded magnetic signal, the reader mechanism may be programmed to refuse admission of the card. Alternatively, or additionally, one of the central regions 34, 35 or 36 may bear an underlying thickness pattern coding which, after

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erasure of the residual value data, and before rewriting of the new residual value, may be scanned to determine whether a correct pattern is present, and therefore whether use of the telephone may be authorised. Since it would be very difficult for the correct pattern to be reproduced fraudently, security of the card is greatly increased.

The card illustrated in Figure 4 is a modified form of standard ISO bank card having a magnetic stripe 40 adjacent to one edge, with data written to some or all of the three parallel tracks therealong. Occasionally, such data extends over only a part 40a of the length of the stripe, leaving the remainder 40b free of data. In accordance with the invention, at least a part of this remainder 40b is provided with permeance variation coding, and a uniform write (or record) signal is applied to the coded part during manufacture of the card, whereby a permeance code pattern may be detected during reading of the card in a card reader. For example, the detection of the presence of code pattern may permit a higher transaction limit than for a card without the code pattern. Data recorded in the data part 40a of the stripe 40 may include a code activating the reading head in the card reader to continue reading beyond the end of the data part 40a. It would be possible to encode the card with any of a plurality of different codes, with the data in part 40a including an indication of which

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code had been used for the part 40b.

In an alternative arrangement of the card shown in Figure 4, the whole of the stripe 40 bears a permeance variation coding, with the data in part 40a being recorded with a signal level pattern corresponding to but opposite to the underlying coding.

Figure 5 illustrates a card which is provided with a standard bank card stripe 50 and a control stripe 51 of the type used in magnetic prepayment cards such as that illustrated in Figure 3. The control stripe 51 is divided into three portions 51a, 51b and 51c, the outer portions 51a and 51c typically being "read-only" data areas, while the middle portion 51b is a "read-write" data area. The stripe 50 may be provided with permeance encoding, as described with reference to Figure 2 or Figure 4 and/or any of the portions of the central stripe 51 may have permeance encoding.

Figure 6 illustrates a memory card used for the storage of data and having the whole of one face thereof coated with magnetic recording material, applied such that at least a part thereof is permeance encoded as hereinbefore described. The whole of the surface may be encoded, or regions corresponding to part or all of one or more tracks

of data may be encoded. Examples of such regions are indicated by reference numerals 60 in Figure 6.

Figure 7 illustrates a conventional card "swipe" device 70 modified to operate in accordance with one aspect of the invention. The device 70 has a channel 71 running along its uppermost surface into which a card, for example of the type illustrated in Figure 4, may be inserted with its magnetic stripe downmost. Running the card along the slot, commonly referred to as "swiping" the card, passes the magnetic stripe past the reading head so that data therein can be read. This data normally passes via a cable 72 to further data handling stages, for example for obtaining clearance for a transaction, or effecting the transaction by electronic funds transfer in conjunction with keyed-in data. In the present embodiment a decoding device 73 is interposed between the "swipe" device 70 and the further data handling stages. The decoding device 73 receives the signals from the "swipe" device 70 and checks for the presence of the correct reassurance pattern in the non-data portion 40b of the stripe 40, passing a suitable enabling signal to the further data handling stages if the pattern is present.

Figure 8 and 9 illustrate different ways of modifying existing card-reading devices to operate with magnetic data media in accordance with the invention. In the embodiment

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of Figure 8, the magnetic reading head 80 is connected via a decoding device 81 to the existing electronics 82 for processing, while in that of Figure 9, the reading head 80 is connected to the existing electronics 82 which is in turn connected to other parts of the data handling chain, represented by the dotted line, and then to the decoding device 81. In each case, the decoding device 81 serves essentially the same function as that described with reference to Figure 7.

In the case where the substrate is a thin flexible tape, the stripe of varying permeance would be directed along the tape preferably at its start, although it could occur anywhere, or even repeatedly along the tape. The printed layers could be printed on the side of the tape remote from its general magnetic coating, or could be printed on the tape before it is coated, or could be printed on the general magnetic coating.

CLAIMS

1. A magnetic data medium including a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance, characterised in that the magnetic recording material (3,4) is defined by a first layer (3) printed onto the substrate (1) and by a second layer (4) printed in a discontinuous pattern on the first layer (3).
2. A magnetic data medium as in Claim 1, characterised in that the magnetic recording material (3,4,6) is additionally defined by a third layer (6) printed in a different discontinuous pattern on the second layer (4).
3. A magnetic data medium as in Claim 1 or 2, characterised in that the thickness of the magnetic recording material varies in discrete equal steps or multiples thereof.
4. A magnetic data medium as in Claim 1 or 2, characterised in that the pattern of varying magnetic permeance includes a portion of the substrate free from

magnetic material.

5. A magnetic data medium as in Claim 1 or 2, characterised in that the substrate (1) has been deformed to accommodate the different printed layers (3 and 4 or 3,4 and 6) thereby presenting a uniform planar surface.

6. A magnetic data medium as in Claim 5, characterised in that the magnetic recording material (3 and 4 or 3,4 and 5) is sandwiched between the uniform planar surface of the deformed substrate (1) and a cover layer (8) laminated to the substrate (1).

7. A magnetic data medium as in Claim 1, characterised in that at least the first layer (3) also defines a discrete data region (21a, or 21b or 35 or 51) of substantially constant magnetic permeance.

8. A magnetic data medium as in Claim 7, characterised in that the discrete data region (35) is separate from the region (30) defining the pattern of varying magnetic permeance.

9. A magnetic data medium as in Claim 1, characterised in that the region of magnetic recording material (3,4) and the substrate (1) are substantially

coextensive.

10. A magnetic data medium as in Claim 9, characterised in that the substrate (1) is a flexible film or tape.

11. A magnetic data medium as in any preceding claim, characterised in that the region of magnetic recording material (3 and 4 or 3,4 and 6) also bears magnetically-recorded data.

12. A magnetic data medium as in Claim 11, characterised in that intensity of the magnetically-recorded data varies in accordance with the predetermined pattern whereby a magnetic reading head passed along the axis will detect a substantially uniform signal level.

13. A method of making a magnetic data medium including a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance, characterised in that a first layer (3) of magnetic recording material is printed directly onto at least a portion of the substrate (1), and a second layer (4) of magnetic recording material is printed in a discontinuous pattern on the first layer (3).

14. A method of making a magnetic data medium as in Claim 13, characterised in that a third layer (6) of magnetic recording material is printed in a different discontinuous pattern on the second layer (4).

15. A method of making a magnetic data medium as in Claim 13 or 14, characterised in that at least one portion of the substrate (1) is kept free of magnetic recording material.

16. A method of making a magnetic data medium as in Claim 13 or 14, characterised in that the substrate (1) is deformed after printing of the layers (3 and 4, or 3,4 and 6) to define a uniform planar surface.

17. A method of making a magnetic data medium as in Claim 13 or 14, characterised in that data is magnetically recorded over the pattern of varying magnetic permeance.

18. A data system including a magnetic data medium formed from a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance and a reader device, characterised in that the reader device includes reading means (70) for

reading the pattern of varying signal levels along the region arising from the predetermined pattern and from data recorded thereon, storage means is provided for storing data corresponding to the predetermined pattern, and processing means is provided to employ said stored data to process the signals read by said reading means to extract therefrom the recorded data.

19. A data system including a reader device and at least one magnetic data medium formed from a substrate bearing a region of magnetic recording material whose thickness varies in accordance with a predetermined pattern to define a pattern of varying magnetic permeance, and having data signals recorded thereon, characterised in that the reader device is arranged to read the composite signal comprising the data signal recorded on the pattern of varying magnetic permeance, and to separate the data signal from the underlying magnetic signature defined by the pattern of varying magnetic permeance.

20. A data system as in Claim 19, characterised in that the reader device is arranged to read the data signal from the pitch of the composite signal and to read the magnetic signature from the amplitude of the composite signal.

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21. A data system as in Claim 19, characterised in that the reader device is arranged to store the composite signal prior to erasing the data signal, subsequently to read the magnetic signature, subsequently to use the magnetic signature to decode the composite signal to obtain the data signal.

22. A data system as in Claim 21, further characterised in that the reader device finally restores the data signal for the region.

23. A data decoding device for extracting magnetically-recorded data from a complex signal read back from a magnetic recording medium in which the thickness of the magnetic recording material varies along the read-back axis in accordance with a predetermined pattern, characterised in that a decoding means (81) is provided for receiving said complex read-back signal, for storing the pattern, and for employing the stored pattern to process the complex read-back signal to extract the recorded data.

1/3

FIG. 1

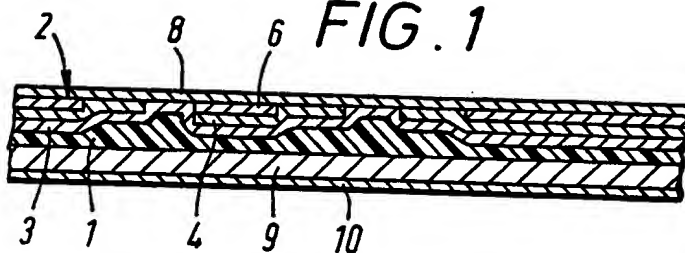


FIG. 2

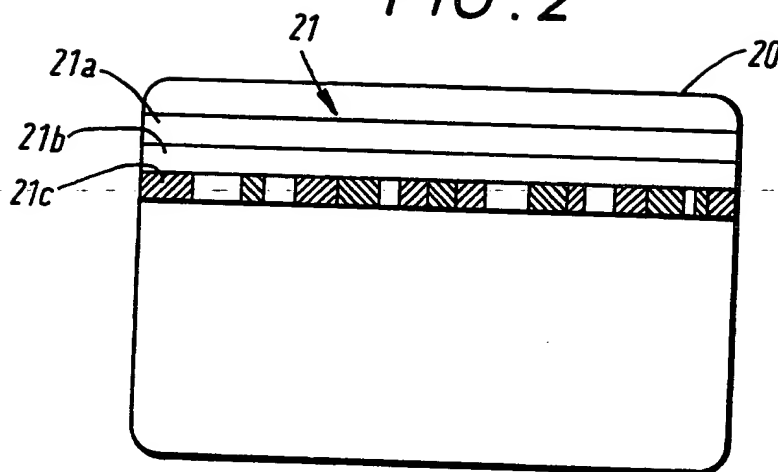
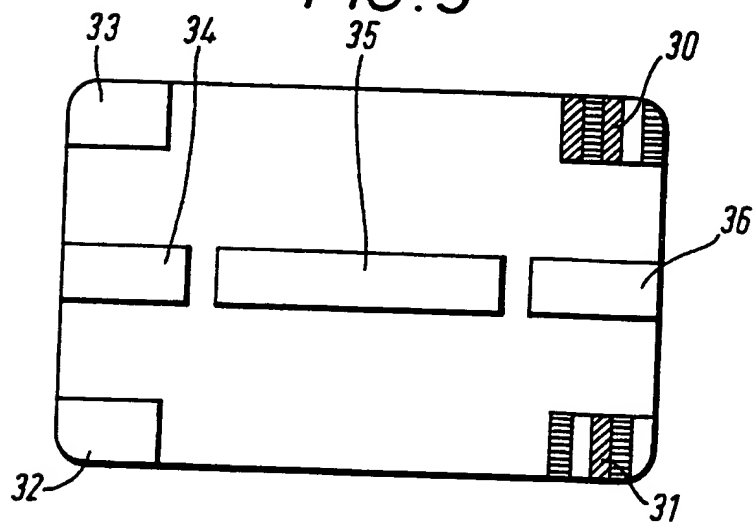


FIG. 3



SUBSTITUTE SHEET

2/3

FIG. 4

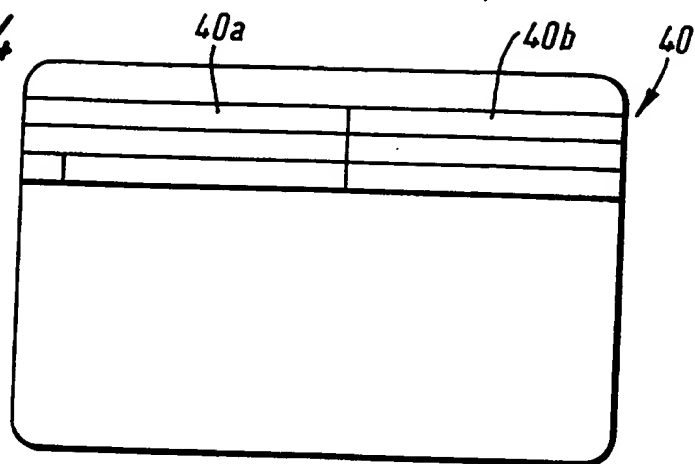


FIG. 5

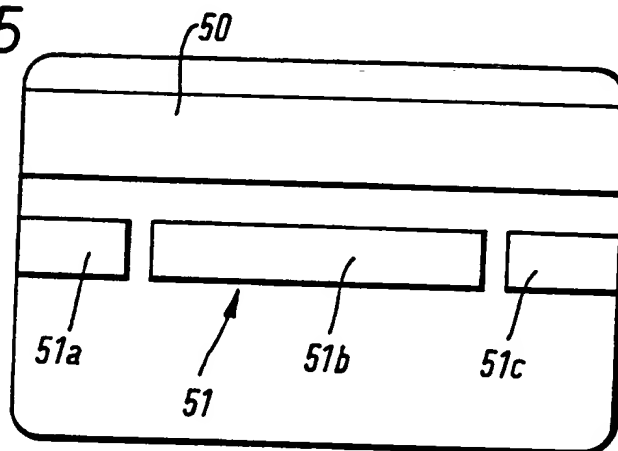
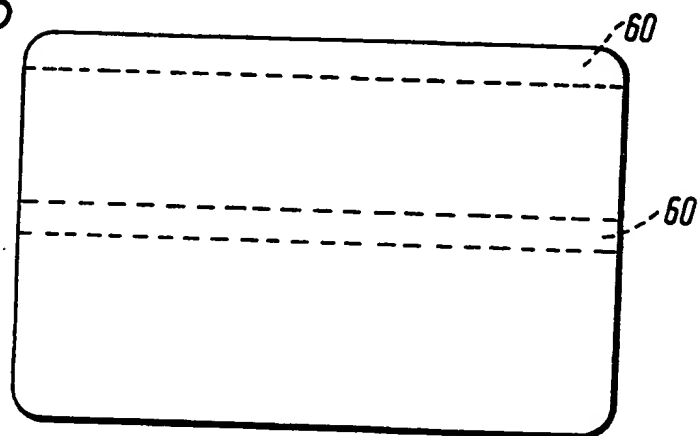


FIG. 6



SUBSTITUTE SHEET

3/3

FIG. 7

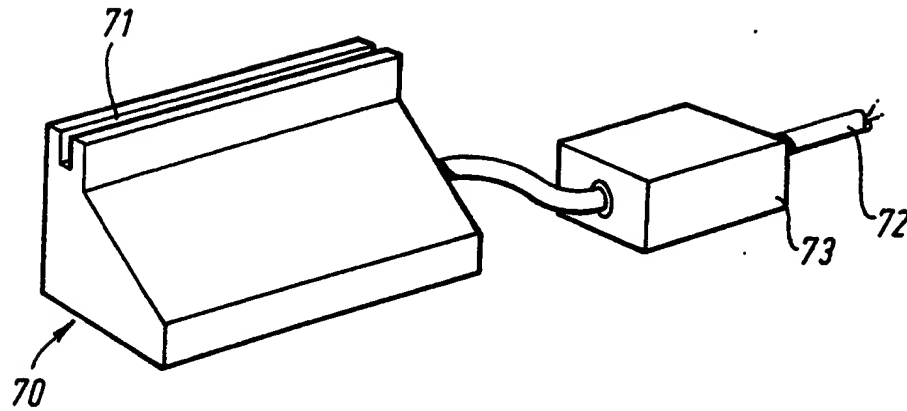


FIG. 8

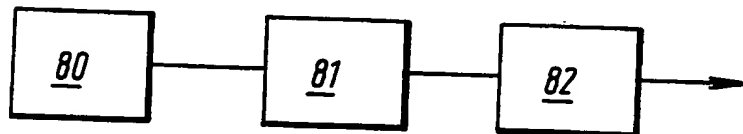
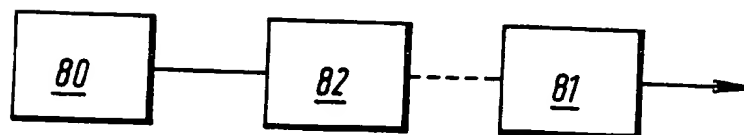


FIG. 9



SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 92/00749

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) * According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁵ : G 11 B 5/84, G 11 B 5/855, G 11 B 5/66		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷ Classification System Classification Symbols IPC ⁵ : G 11 B 5/00		
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	EP, A2, 0 162 349 (INTERNATIONAL BUSINESS MACHINES CORPORATION) 27 November 1985 (27.11.85), see claim 1.	1, 13, 18
X	WO, A1, 87/05 728 (SKI-DATA) 24 September 1987 (24.09.87), see claim 1.	1, 13, 18
A	WO, A1, 90/07 755 (COIN CONTROLS) 12 July 1990 (12.07.90), see claim 1.	1
A	EP, A1, 0 033 041 (RHONE-POULENC) 05 August 1981 (05.08.81), see claim 1.	1
A	US, A, 4 777 540	19
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Z" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search <div style="text-align: center;">16 June 1992</div>		Date of Mailing of this International Search Report <div style="text-align: center;">10 JUL 1992</div>
International Searching Authority <div style="text-align: center;">EUROPEAN PATENT OFFICE</div>		Signature of Authorized Officer <div style="text-align: center;">Mme N. KUIPER </div>

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, " with indication, where appropriate, of the relevant passages	Relevant to Claim No.
	<p>(McCOY) 11 October 1988 (11.10.88), see claim 1. -----</p>	

ANHANG

zum internationalen Recherchen-
bericht über die internationale
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ANNEX

to the International Search
Report to the International Patent
Application No.

ANNEXE

au rapport de recherche inter-
national relatif à la demande de brevet
international n°

PCT/GB 92/00749 SAE 58734

In diesem Anhang sind die Mitglieder
der Patentfamilien der im obenge-
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This Annex lists the patent family
members relating to the patent documents
cited in the above-mentioned inter-
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* Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
EP A2 162349	27-11-85	CA A1 1241741 EP A3 162349 JP A2 60261083	06-09-88 07-09-88 24-12-85
NO A1 8705728	24-09-87	AT A 648/86 AT B 392169 EP A1 296172 JP T2 63502705 US A 4929821 AT A 647/86 AT B 389677 AT A 384/89 AT B 391034 AT A 646/86 AT B 389777 AT A 645/86 AT B 389953	15-07-90 11-02-91 28-12-88 06-10-88 29-05-90 15-06-89 10-01-90 15-01-90 10-08-90 15-06-89 25-01-90 15-07-89 26-02-90
NO A1 9007755	12-07-90	AU A1 48009/90 GB A0 8830106	01-08-90 22-02-89
EP A1 33041	05-08-81	keine - none - rien	
JS A 4777540	11-10-88	keine - none - rien	

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